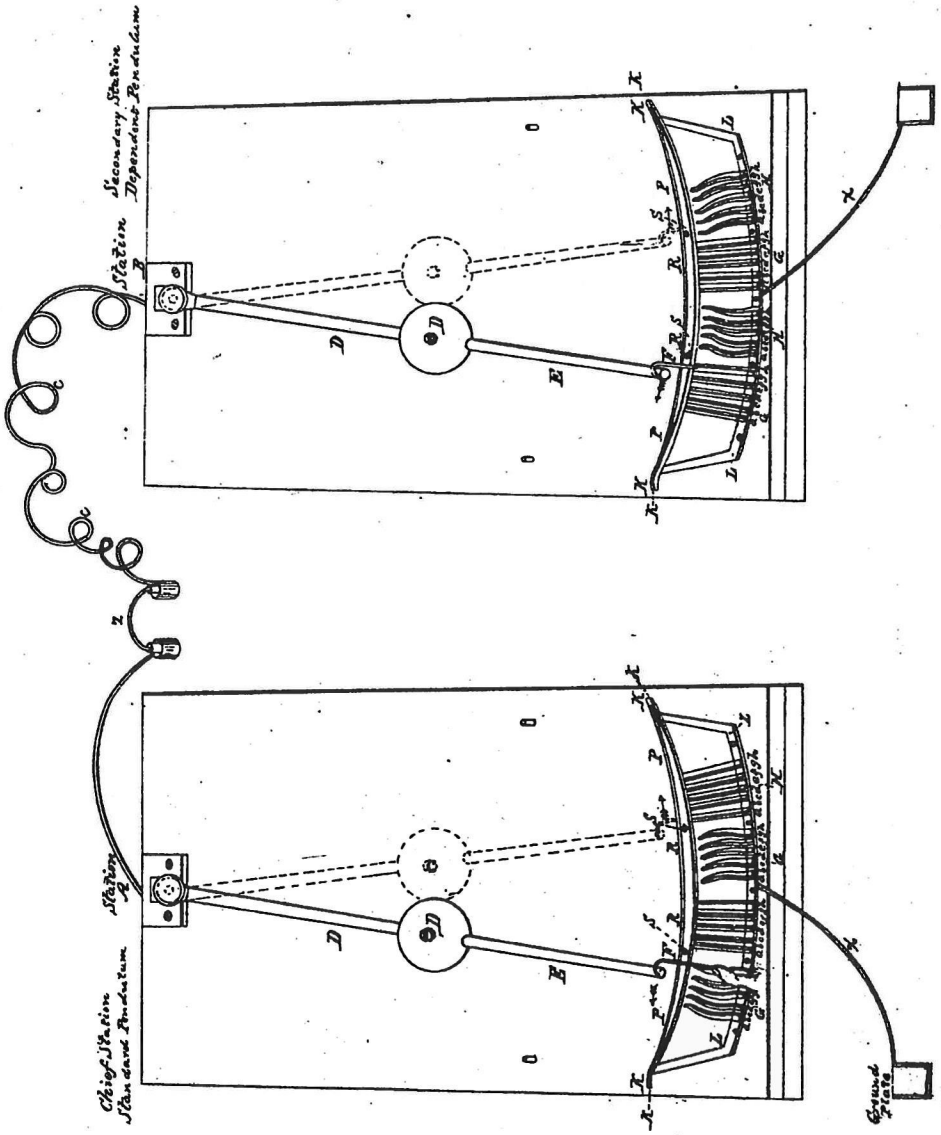
2 Sheets—Sheet 1.

H. G. DYAR.

Telegraph.

No. 17,673. Patented June 30, 1857.



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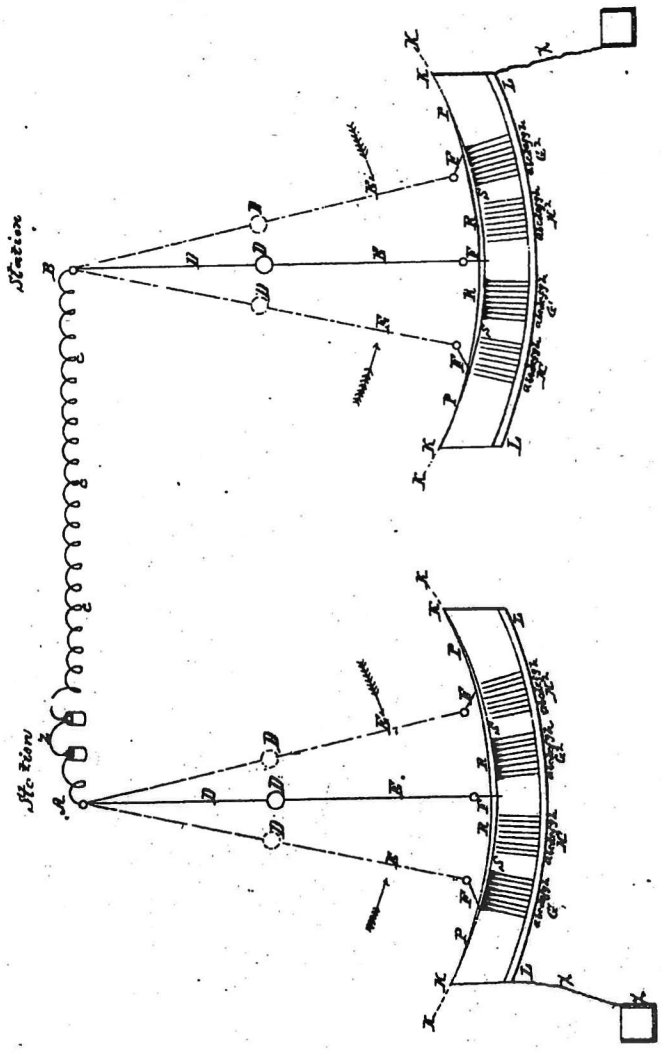

UNITED STATES PATENT OFFICE.

HARRISON GRAY DYAR, OF NEW YORK, N. Y.

IMPROVEMENT IN ELECTRIC TELEGRAPHS.

Specification forming part of Letters Patent No. **17,673**, dated June 30, 1857.

To all whom it may concern:

Be it known that I, HARRISON GRAY DYAR, of the city, county, and State of New York, have invented certain new and useful Improvements in the Art of Communicating Intelligence by Electricity; and I do hereby declare that the following is a full, clear, and exact description of my said invention, reference being had to the drawing which is hereunto annexed.

The apparatus forming the subject of the present invention is termed by me an "electrepode"—*i. e.*, electric-word road—and the species of language or form of communication I designate "electrep"—*i. e.*, electric word.

Electric telegraphs may be divided into two classes—the copying-telegraph and the signalizing-telegraph. By the former a skeleton fac-simile of the message sent is made at the opposite end of the line of communication. The principal telegraphs constructed upon this principle are those of Bain and Bakewell. They are founded upon the fact that a current of electricity has the property of decomposing various chemical substances, and consequently of discoloring or producing a stain upon paper prepared with such substances through which the electric current is passed. Hence if a sheet of an electric conducting material having the characters or letters of a message written upon it in some non-conducting material or ink be connected with some source of electricity and be passed in the direction of the writing and at a given speed beneath a style attached to one end of a main conducting-wire extending between two points, the continuity of the electric current proceeding from the sheet of conducting material to the main conductor through the style will be broken as often as the non-conducting ink of any portion of any written character passes beneath the style, and if there be a style at the opposite end of the main conductor under which a sheet of chemically-prepared paper is passed at the same speed as the sheet of non-conducting material, the paper will be discolored in those portions which pass beneath the style while the electric current is passing, but will be left of its original tint at those parts which pass the style while the electric current is broken by the intervention of the ink of the letters of the message beneath the opposite style. If the styles are pointed, each will describe a line upon its respective sheet, and the first passage of a message beneath the first style will be followed at the other style by the formation on the paper of a line of disconnected dashes separated by dots of the original tint which correspond in position with the parts of the letters of the message which passed beneath the first style. If the message and paper be passed and repassed a number of times beneath their respective styles, and if at each repassage the two be shifted a slight distance transversely to the direction of the writing, the message will be reproduced upon the paper in skeleton letters formed of dots of the original tint separated by discolored dashes.

In some cases the process has been reversed, so that the skeleton letters are formed of discolored dots upon a ground of the original tint. In either case each letter or character of the message requires a number of changes of the electric influence, or the transmission of a number of short electric currents, to give the corresponding skeleton character such a form as shall distinguish it from other characters or letters. Hence it has been customary either to pass the message a number of times beneath one style or to pass it once beneath a number of styles extending in a series the height of the writing or printing. This mode of telegraphing has fallen into disuse, the reasons being, in my opinion, the great number of changes of electric connection required to render the characters distinct and the practical difficulties attending the use of the apparatus employed.

The copying-telegraph, operating on the principles above mentioned, is clearly distinguished from the signalizing-telegraph, to which my invention has reference. In this latter class each letter, word, or syllable of a message is represented by a distinct signal. These signals are transmitted in succession along the main conductor, and are indicated or recorded at the place where they are received. The different kinds of telegraphs constructed upon this principle are distinguished from each other either by the kind of signals employed or by the mode and apparatus by which the signals are transmitted and recorded. In some telegraphs of this description the letters

of which a message is composed are represented by simple signals or single passages of the electric current of different lengths, or they are represented by compound signals formed by successive passages of the electric current separated by intervals; or these two modes are combined. In other telegraphs all the letters have been represented by simple signals or single passages of the electric influence without regard to their duration, and the different significations of the signals are indicated by the different positions which the members of the recording apparatus occupy at the time the different signals are received. In this latter case, as well as in those first referred to, the telegraphing by the main conductor proceeds no faster than the operator can make the muscular efforts required to operate his particular telegraphic apparatus, and the main conductor is occupied exclusively by one operator. The speed with which messages are telegraphed is thus limited by the manual dexterity of the operator, and the main conductor is not employed by any other operator for transmitting messages, either in the same or in the opposite direction, until the first operator has suspended or finished his work; hence, if messages are to be transmitted simultaneously on the signalizing principle, as many operators are put to work as there are messages to be simultaneously transmitted, and as each operator requires the exclusive use of a main conductor extending from station to station, there must be as many main conductors as there are operators at work at the same time.

The object of my invention is to enable two or more operators to be simultaneously employed in telegraphing different messages by signalizing along the same main conductor or wire of communication, and to permit each operator to work as fast as his manual dexterity will permit, so that, although many operators may be required to make the necessary muscular efforts or distinct voluntary acts to transmit the signals representing many different messages, either in the same or in opposite directions, all these signals will proceed along one common wire of communication or main conductor, and will be indicated or recorded at the places where they are received with the same distinctness and with the same speed that they would be if each operator at work at the time was furnished with a distinct and exclusive main conducting-wire.

My invention consists in constructing and operating telegraphic apparatus in such manner that the electric current representing each different signal may be transmitted to the main conductor or wire of communication in a practically instantaneous manner, or in the form of an impulse or pulsation, however long a time is consumed by the operator in making the muscular bodily movement for the purpose, so that the successive impulses representing the various signals forming a telegraphic message will be separated by intervals of time depending upon the dexterity of the operator, and that during these intervals similar impulses representing different messages, resulting from the muscular efforts of other operators employed at the same time, may be transmitted to the same main conductor, either in the same or in opposite directions.

My invention is based upon the circumstance that, practically speaking, no sensible portion, or at best an extremely minute portion, of the time employed in working a signalizing-telegraph is consumed in imparting the electric influence which is the agent of communication to the main conducting-wire, but that the great portion of the time expended is consumed in the operation of making or recording the signals, during which the current or passage of electric influence is unnecessarily maintained. Hence, if telegraphic apparatus be constructed in such manner that the employment of the electric influence is required for but one instant of time to make any required signal, one wire of communication or main conductor reaching between the distant places may be made the instrument of transmitting, either in the same or in opposite directions, an indefinite number of instantaneous impulses representing different signals in a second of time, provided the telegraphic apparatus be constructed in such manner that so many different impulses representing distinct signals may be imparted separately and in succession to either end of the main conductor and correspondingly received, distributed, and indicated or recorded at the other end thereof in an intelligible manner.

This invention may be applied to practice in various modes, differing more or less in the arrangement and construction of the apparatus and in the modifications of electric action applied. It is, however, essential to my invention, so far as my present experience extends, that a telegraphic apparatus embodying it must contain a means by which the different electric impulses resulting from the actions of different operators shall be imparted in succession to the common main conductor, so that the impulses resulting from the action of one operator shall alternate with those of other operators upon the same conductor, and it must also contain a means by which the different electric impulses thus successively imparted to the main conductor shall be received therefrom separately and in the same succession in which they were imparted to it, and that they shall be distinguished from each other, so that each may be appropriated to reconstruct the particular message of which it forms a part. The speed at which the apparatus is driven should be at least equal to the sum or number of the muscular efforts which the different operators employed can make in signalizing in a given period of time. Thus, if an operator can make four muscular movements corresponding with as many signals in a second of time and two operators are put to work at the same

time, the apparatus should at least be capable of making eight changes of electric connection per second, and practically it should be driven faster than this rate.

A simple mode of applying this improvement to practice and for illustrating the principle of the invention is represented in the accompanying drawing, in which are shown two pendulums situated at the opposite ends of a telegraphic conductor, C C, and supposed to be actuated by clock-work or other suitable means, so as to move in harmony, or, in other words, to vibrate from *k* to *k* as nearly as possible together in position and in time of vibration.

At station A is the standard-pendulum or chief station in reference to station B or other dependent telegraphic stations.

D D are the pendulum-rods with their balls or weights.

E are the prolonged ends of the pendulum-rods, which should be made longer in proportion than represented in the drawings.

F are very flexible springs united to the prolonged ends of the pendulum-rods.

P R P and P S P are two grooves or pathways, so made that the springs F shall move in the grooves P S P when the pendulums make the vibrations in moving from left to right and shall fall into the grooves P R P when making the vibration in moving from right to left.

C C C is the main conductor or wire of communication connecting the two telegraphic stations A and B together.

L L are conductors extended in directions parallel with the paths described by the extremities of the pendulums, and connected with ground-plates and ground-wires *x x*.

At K, station A, there are metallic points or edges, over which the spring F passes, touching the surface each vibration, which points are connected with the conductors L, and consequently are in electric communication with *x*.

The groove P S P is made of a non-conducting material, and the groove P R P at station B is of metal and in electrical communication with L and *x*.

The spring F at station A, in moving in either of the grooves P R P or P S P, is kept in its path by an insulated or non-conducting guide.

z is a Leyden jar, a prime conductor of an electrical machine or a galvanic battery, kept constantly charged or capable of giving a great number of visible sparks or electric pulsations per second on making or breaking the electric circuit or line of inductive action.

The main conductor C C C has a metallic connection with the upper end of the pendulum-rods, which are also metallic, as well as their prolonged terminations, and are therefore good conductors of electricity. In this condition of things, whenever the spring F at station A passes over the points K K in its vibration there will be an electric communication or circuit from *z* to K, and thence through L and *x* to the ground at station A; also, from *z* to the metallic groove P R P at station B and to the ground there, provided the pendulum at station B is making its vibration from right to left when the pendulum at station A carries its spring F over the conducting-points K.

H′ and H² at both stations are signal-making wires or keys, and G′ and G² at both stations are signal-receiving wires. The signal-wires are to be supposed as numerous in each set as the numbers of different signals desired to be used—say not less than the letters of the alphabet. A smaller number is shown in the drawings for the sake of distinction. The inner extremities of all the signal-receiving wires are flattened, and reach into the grooves or pathways P S P in such a manner that the spring F shall touch and glide over the flattened faces or ends of these wires in succession each time the pendulums move from left to right. The inner extremities of the signal-making wires, on the contrary, stand a little off out of the grooves or pathways, but are mounted in such manner that each may be raised by the pressure of the finger and brought into the line of the groove or pathway, to be touched by the spring F when the pendulum swings from left to right. All these signal-wires are connected at their outer ends with the conductors L L, but are free and independent at their inner ends.

The free ends of the signal-receiving wires may have a width of half an inch (more or less) where F passes over them, but must not touch each other. The corresponding ends of the signal-making wires should be but an edge or line, so that the signal-making wires can be touched by F but for a moment, while the signal-receiving wires will be touched for a sensible time by F in passing over them, by which arrangement the necessity of absolute synchronism in the movements of the two pendulums is avoided. Under these circumstances, if any one of the signal-making wires H′ at station A be moved without breaking its electric connection with L, so that the end F of the vibrating pendulum will come in contact with the end of the wire, a conducting-circuit or electric current will be established for the moment through the whole system of conductors, for, as the pendulums are moved in harmony, the corresponding pendulum at station B will at that moment be in front of the group of signal-receiving wires G′ of that station. Therefore from the electric circuit existing for that moment of contact there would be a spark visible or an electric pulsation upon the flattened end of that one of the signal-receiving wires at station B which corresponds with that one of the signal-making wires at the other station which may have been pressed upon and brought into the pathway of F. If, therefore, all the signal-wires in each set are marked by and signify the different letters of the alphalet, the left-hand wire of each set being

marked *a*, the next *b*, next *c*, &c., then should *a*, *b*, or *c* of a signal-making group, H′, station A, be pressed upon so as to be touched by F, this act will be known at station B by the appearance of a spark on the end of that one of the signal-receiving wires *a*, *b*, or *c* of group G′, station B, which corresponds to that wire which may have been so touched at station A. Thus at will can any signal or letter be sent from station A to station B; and during the operation of signal-making by one person at station A to a second person at station B by the use of one set of wires, H′, a third person at station B, or the same person who receives the first message or set of signals from A, can telegraph in reply to station A by making use of the set of signal-sending wires H′ of station B, in a manner similar to that in which the wires of station A, before described, were used. The electric pulsations thus transmitted to the main conductor by the action of one operator will alternate with those transmitted to it by the action of the other operator, and if the time of a double vibration of these pendulums is equal to the time necessary for conveniently making and observing a signal, then by the use of the four sets of signal-wires above named a person may send to or receive signals from or between the stations A and B reciprocally; or four persons may be continually and simultaneously employed in making and receiving signals at the two stations over a single main wire. The pendulums, in this example combine or connect the main conductor with the sets of signal-sending and signal-receiving wires, making the circuit complete as often as a signal-sending wire is placed in a position to impart electricity to them, and breaking the circuit as often as such signal-sending wire is passed in the movement of the apparatus. The pendulums thus constitute circuit-making and circuit-breaking apparatus, which, as before stated, are moved in harmony at the two stations, and combine the main conductor with the sets of signal-sending and signal-receiving apparatus.

The use of the signal-wires above referred to as able to employ four persons in continual telegraphic intercourse will in no way interfere with the simultaneous employment of two or four other operators using the other signal-wires on the right-hand half of the vibrations marked H^2 and G^2, because the electric pulsations resulting from the actions of the various operators at work will be transmitted in succession to the main conductor, and will at the same time alternate with each other, and they will be correspondingly separated and distributed at the opposite end of the conductor, so that the signal of any one operator will be imparted to the main wire during the short intervals of time occupied by the other operators in making the muscular efforts which are necessary to operate the particular signalizing apparatus. So, also, by lengthening out the ends of the pendulum-rods or increasing the angular motion of the apparatus for circuit-making and circuit-breaking, or by causing them to revolve in a horizontal circle instead of vibrating, more space or places may be had for carrying on a much larger number of telegraphic operations.

At K, on the left-hand side of the standard-pendulum, there are two metallic points or faces near together in communication with L, and the groove P R P at station B is a metallic or conducting groove. By this arrangement it can be known at station B when the pendulum at station A is in motion and the position of its vibration exactly determined, so that the pendulum at B can be from time to time set in motion, accelerated, or retarded, in order to maintain that degree of synchronism in the action of the pendulums and similarity in positions which are necessary for the success of the telegraphic operations. When the pendulum at B is correctly timed in its motion there will be visible two sparks on the left-hand extremity and one spark on the right-hand extremity of the conducting-groove P R P at points K K, station B, equally distant from the center of vibration; but when this pendulum is not in its proper position or motion these sparks will be seen at other places along the groove. The pendulum at station B may thus be kept adjusted to the motion of the regulating-pendulum by the appearance of sparks at K K; but this synchronism may be more perfectly maintained by using any of the known or suitable electro-magnets by which two pendulums or a system of pendulums have been or can be made to vibrate together, in which case the metallic conducting-groove would not be required.

In the above description the electric spark from an electrical machine has, for simplicity, been chosen as the visible signal; but should it be desired to make signals by the hydro-electric current and the deflection of a needle, then each one of the signal-receiving wires, before uniting with the common conductor L, may be lengthened out sufficiently to form the coil of a galvanometer. In this case the current passing through any one of these wires can make itself known or the signal be indicated by the deflection of the needle of the galvanometer belonging to that particular signal-receiving wire so signalized, or in like manner these prolonged signal-receiving wires may each one inclose a bar of iron in place of a magnetic needle, so as to have an electric magnet and keeper belonging to each one of these wires. Then the passage of the current through any of the wires will give magnetism to the bar or actuate the maguet or its keeper, from which motion these signals may be perceived or recorded or printed in any convenient form.

In the above description I have illustrated the nature of the invention by showing its action in connection with two telegraphic stations; but it will be obvious to the skillful en-

gineer that divers stations and complex systems of telegraphic lines of communication can be established on the same general principle. Moreover, in the above description I have supposed the signal to be transmitted along the main conductor by means of a positive electric pulsation or by the establishment of an electric current over a main conductor previously unoccupied by an electric current. It will be obvious to the skillful engineer that a signal may be transmitted equally by means of a negative electric pulsation or by breaking an electric current previously proceeding continuously over a main conductor.

In the apparatus thus described the means by which the electric circuit is made and broken so as to impart the electric pulsations in their proper succession to the main conductor at one end of the line and the corresponding means by which the electric circuit is made and broken so as to distribute the electric pulsations at the other end of the main line and distinguish the different signals are moved in harmony; but these portions of the apparatus have no positive connection with the indicating or recording apparatus, and are not impeded or controlled by the latter. Hence these portions of the apparatus move on under the same constant resistance, whether one or more operators are at work, and will continue to move on under the same constant resistance if permitted to move while the line is not at work. This independent operation of the circuit making and breaking apparatus with respect to the other accessories of the telegraph is of great importance, as experience has proved to me that if the circuit making and breaking apparatus at either end of the line be retarded, even momentarily, by imposing upon it any irregular work—as, for example, by connecting it with mechanism for recording or printing the signals—the motion of the apparatus will be affected to such a degree as to render it difficult to maintain the harmonious or synchronal movement at the two stations.

In the apparatus hereinbefore described the movement of the circuit-making and circuit-breaking apparatus is not stopped at the time of the transmission of the electric influence to or from the main conductor; but these portions of the telegraphic apparatus move on in a continuous manner, however long a time may be required by the indicating mechanism to render a signal visible to the eye or to record it. This portion of the invention is a new feature in signalizing-telegraphs, in which it has been customary to stop the movement of the circuit-making and circuit-breaking apparatus during the indication or recording of the message.

It will also be understood that this invention is susceptible of an indefinite number of modifications or forms as respects the apparatus employed in carrying it into use. Only such, therefore, has been indicated as may be necessary for the distinct understanding of the characteristic quality or nature of this invention which distinguishes it from all other electric telegraphs.

I do not claim any particular mode of obtaining the synchronism of the vibrations, nor confine myself to vibrations or any particular form of motion to produce the like effect, nor the use of any particular means for obtaining the electric action, nor the kinds of signals, signs, marks, or recording, nor particular modes of arranging the apparatus, leaving it to those who use my invention to employ such apparatus, whether vibratory, rotary, or oscillatory, as they may deem best suited to accomplish the objects desired under the different circumstances which may arise; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. Constructing and operating signalizing telegraphic apparatus in such manner that electric pulsations representing signals resulting from the actions of two or more operators at work at the same time are imparted alternately and successively to a single main conductor or wire of communication and received therefrom and distributed in the same alternating succession, whereby a single main conductor may be made the instrument by which two or more operators can be simultaneously employed in sending different messages either in the same or in opposite directions, substantially as herein set forth.

2. Transmitting different electric signals resulting from the actions of two or more operators working at the time at the same or opposite ends of a single main conductor by means of a single main conductor, combined with two or more sets of corresponding signal-sending and signal-receiving conductors, which represent the different signals in use, and are appropriated to different operators by means of intermediate circuit-making and circuit-breaking apparatus, which are moved in harmony at the signal-sending and signal-receiving stations in such manner as to present themselves successively in all the positions required to permit currents of electricity to be passed alternately through the corresponding members of the signal-sending and signal-receiving conductors, whereby the apparatus at each station can at the same time be employed in transmitting and receiving signals representing messages, substantially as herein set forth.

3. Transmitting electric pulsations to a main conductor and distributing them from the same main conductor by two sets of circuit-making and circuit-breaking apparatus, which are moved in harmony with each other, but are moved by mechanism independently of the other portions of the telegraphic apparatus in such manner that the harmonious movement of the circuit-making and circuit-breaking apparatus at either end of the main conductor

is not impeded or controlled by the irregular movement of other parts of the telegraphic apparatus.

4. Sending and receiving signals, as above stated, by apparatus so arranged and combined with the main conductor that in operating the impulse that closes or opens the circuit shall last but for a moment, while the contact maintained at the station where the signal is received shall last a longer period, so as to obviate the necessity of exact synchronism in the movements of the mechanism at the two stations.

In testimony whereof I have hereunto subscribed my name.

HARRISON GRAY DYAR.

Witnesses:
J. WILSON GREEN,
WM. LEE BENNEM.